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COMMITTEE ON WATERS AND WATER POWERS

Power Possibilities on the
St. Lawrence River

BY

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Consulting Engineer
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IN May, 1908, nearly ten years ago, the Conference of Governors was called together in a memorable session at Washington by the President of the United States. It resulted in the formation of the Commission of Conservation of Canada, and policies adopted at that conference and subsequently carried into effect, have markedly affected, not only the United States but also Canada and, indeed, the world at large. It was, also, so clearly demonstrated that several of the chief natural resources of the United States were within measurable distance of exhaustion, that prompt action by the trustees of the nation became imperative.

Addressing the Conference, the President of the United States, Mr. Roosevelt, said:

"This nation began with the belief that its landed possessions were illimitable and capable of supporting all the people who might care to make our country their home; but already the limit of unsettled land is in sight, and indeed but little land fitted for agriculture now remains unoccupied save what can be reclaimed by irrigation and drainage. . . . We began with an unapproachable heritage of forests, more than half of the timber is gone; we began with coal fields more extensive than those of any other nation and with iron ores regarded as inexhaustible, and many experts now declare that the end of both iron and coal is in sight. . . . The enormous stores of minerals, oil and gas are largely gone. . . . Our natural waterways are not gone, but they have been so injured by neglect, and by the division of responsibility and utter lack of system in dealing with them, that there is less navigation on them now than there was fifty years ago. Finally, we began with soils of unexampled fertility, and we have so impoverished them by injudicious use, and by failing to check erosion, that their crop-producing power is diminishing instead of increasing. In a word, we have thoughtlessly, and to a large degree unnecessarily, diminished the resources upon which not only our prosperity but the prosperity of our children and our children's children must always depend."

The Commission of Conservation of Canada has been endeavouring to have our natural resources so developed that they will, so far as possible, be passed on to succeeding generations unabused by the uses to which they must now be applied. Special attention has been

devoted to the beneficial use and conservation of Canada's water resources, and some of our earliest activities consist of investigations respecting the character and extent of the water-powers of Canada. In presenting the results of its research, the Commission, from time to time, has advised respecting such subjects as water-power development, the improvement of navigable rivers, the necessity for protecting against damage by flood, the preservation of soils against erosion, and the conservation of underground waters.

Some resources such as minerals—more especially coal, oil, and gas—if used, must eventually become exhausted. On the other hand, such resources as the soil, forests, waterways and ground waters, may be conserved, and, just as a good husbandman passes on his farm in an improved condition to that in which he received it, so the policies advocated by this Commission have been directed to the passing on to succeeding generations in an improved condition, the heritage of the natural resources of Canada.

Power Shortage
in Eastern
Ontario

The water-powers of the St. Lawrence river are, as yet, largely within the control of the people. There is, however, a shortage of hydro-electric power which is being keenly felt both in Canada and the United States, and strong efforts are being made by private interests to obtain control of the enormously advantageous power in, and adjacent to, the international boundary waters.

The city of Montreal and vicinity are well supplied with electric energy but, comparatively speaking, the rates are high. If more energy were available at considerably lower rates, electric power and light would be much more extensively used both in factory and home. If large supplies of electric energy be made available at low rates, rigid inspection should be enforced to prevent extravagant and wasteful use.

There has been great shortage of power for supplying municipalities in Eastern Ontario. At the present time, the Hydro-Electric Power Commission of Ontario has urgent requests from such municipalities as Brockville, Prescott, Winchester, Chesterville, Cornwall, Mille Roches, Smiths Falls, Perth, Carleton Place, Kemptville and Almonte, for electric power to take care of connected loads aggregating from 15,000 to 20,000 h.p., with a present peak load of not less than 8,000 h.p.

Although Eastern Ontario is not so extensively engaged in manufacturing as Southwestern Ontario, it is well to recall that in the autumn of 1910, when the Ontario Hydro-Electric commenced operating its Niagara system, it was supplying only about

8,000 h.p. On this system alone; it is now, December, 1917, supplying more than 100 municipalities with over 200,000 h.p., and, in addition, some 50,000 h.p. is supplied to munition plants in the Niagara district.

**Canadian Power
for U. S.
Municipalities**

The power shortage in Eastern Ontario is acute. It had been hoped that power would have been available from the large development at the Cedars on the St. Lawrence river, but this power, although conveyed through the territory of the municipalities requiring power was taken *en bloc* to the works of the Aluminum Company of America situated at Massena, N.Y. Notwithstanding the suggestion that the needs of Canadian municipalities might be supplied by power brought back from Massena to Canada, this has not been done, but, instead, it is being sold to municipalities in the northern part of New York State. Great industrial advantage has followed the utilization of this power generated in Canada and exported to the United States.

During recent Hearings, conducted at Niagara Falls, N.Y., and elsewhere, by the Committee on Foreign Affairs of the House of Representatives, two points were prominently emphasized by representative citizens; first, that the United States could not afford to permit the removal of industries to other countries to secure cheap power and, second, that industries requiring large blocks of power were often compelled to go where they could get it. The United States has already lost industries to Norway and to Canada.

**Public Opinion
Against
Exportation**

There is very strong opposition, especially throughout Ontario, to any policy which permits our exportation of electric energy required for use in Canada. The Federal Government has been memorialized upon this subject. It has been urged that no large power projects such, for example, as those on the international portion of the St. Lawrence river, should be developed without reserving Canada's share of the power for use here; and, further, that powers situated wholly in Canada should be reserved against the day of Canada's need. This statement is made having in mind the fact that it is not the policy of Canada to embargo her exports but that commodities of national importance should not be exported without an adequate *quid pro quo*.

If power is developed, as is proposed at the Coteau rapids, it is much more important that it be reserved for the use of such municipalities in Quebec and Ontario as would naturally be served thereby, than that it be exploited by private interests, or exported to build up industries in the United States. The proposed application of the Power Development Co., Limited, for the rights of power

development at the Coteau rapids* is being opposed by the Commission of Conservation and other organizations.

**Coal
Situation**

As never before, the public interest has been aroused respecting both its fuel supply and its increasing dependence upon hydro-electric energy. The central portion of Canada depends upon the United States for its coal, and war conditions are driving home to Canadians the tremendous gravity of their position.

The extent to which electric energy will be available for heating has been much overrated and, realizing the underlying physical limitations, one cannot be enthusiastic respecting the extent to which it will be utilized. Of course, where large blocks of power are available at low rates, some will doubtless be so used. The availability of such power accounts for the establishment of large electro-chemical industries at Niagara and other centres, but, when the demand for power for municipal and small manufacturing purposes becomes more urgent, such works will probably be forced to leave present sites. Manufacturers and others who are ready to pay from \$50 to \$100 per electric horse-power year, will not readily submit to industries utilizing the coveted power at rates of from \$10 to \$20 per horse-power.

What I said in 1910 on the coal situation is equally true today:

"Certainly the people of Canada are in better circumstances to maintain a supply of heat and power if their water-powers, including their full share of international water-powers, are reserved to themselves and not permitted to be exported except upon terms and conditions which will conserve absolutely the present and future interests of the citizens of Canada. Not only would the water-powers of Canada provide, to a certain extent, a substitute for the coal supply of the United States as a means of furnishing light, heat and power, but control of these water-powers would secure a basis upon which negotiations for coal could be conducted in a possible day of need. Canada would be in a position to exchange, if need be, part of her electric energy for part of the coal supply of the United States. It is obvious, however, that if the United States' interests should control both the coal and the water-powers, the situation of Canada would become exceedingly grave."†

*For Notice of Application to the Dominion Government, made by this company under the *Navigable Waters Protection Act*, R.S.C., chap. 115, see *Canada Gazette*, Sept. 22, 1917, p. 969.

†Respecting various phases of this subject, consult articles by Arthur V. White on *Exportation of Electricity* in *University Magazine*, October, 1910, pp. 460 *et seq.* and *Exportation of Electricity—An International Problem: Relation of a Possible Coal Embargo by United States to a Curtailment or Stoppage of Canada's Electric Power*, in *Monetary Times*, January 5th, 1917, pp. 21 *et seq.* Consult also, *Toronto World*, March 18th, 1912; also *Annual Reports* of Commission of Conservation, Ottawa.

Concentration
of Control

Upon this, it is not necessary for me to enlarge, but I shall deal more particularly with the shortage of hydro-electric energy. Most of the water-powers which are more readily capable of economic development in Canada, as well as in the United States, either have already been developed or are privately controlled. Concentration of ownership is a noticeable feature of this control. It has been authoritatively stated that, in the United States, in 1913, about 6,300,000 h.p. was controlled by ten groups of interests, and this concentration is still going on. Owing both to Provincial and Federal legislation, it has not been possible for interests so readily to obtain control of water-powers in Canada. Efforts, however, are continually being made to secure the rights for such desirable water-powers as are yet vested in the state. In this connection, the efforts made by the powerful financial interests behind the Long Sault Development Co. to obtain control of the almost unequalled power rights at the Long Sault rapids on the St. Lawrence river, are particularly pertinent.

Of the extent to which they may be compelled to pay tribute to those monopolizing hydro-electric powers through control of distribution and supply systems, the public cannot be too well informed. On this point, Mr. Gifford Pinchot has said:

"Whoever dominates power, dominates all industry. Have you ever seen a few drops of oil scattered on the water spreading until they formed a continuous film, which put an end at once to all agitation of the surface. The time for us to agitate this question is now, before the separate circles of centralized control spread into the uniform, unbroken, nation-wide covering of a single gigantic trust. There will be little chance for mere agitation after that. No man at all familiar with the situation can doubt that the time for effective protest is very short. If we do not use it to protect ourselves now, we may be very sure that the trust will give hereafter small consideration to the welfare of the average citizen when in conflict with its own."

Respecting the attempt to create a monopoly of water-powers of the United States, President Roosevelt, in accurate prophetic terms stated:

"The people of this country are threatened by a monopoly far more powerful, because in far closer touch with their domestic and industrial life, than anything known to our experience. A single generation will see the exhaustion of our natural resources of oil and gas, and such a rise in the price of coal as will make the price of electrically-transmitted water-power a controlling factor in transportation, in manufacturing, and in household lighting and heating. Our water-power alone, if fully developed and wisely used, is probably sufficient for our present transportation, industrial,

municipal, and domestic needs. Most of it is undeveloped and is still in national or state control. To give away without conditions, this, one of the greatest of our resources, would be an act of folly. If we are guilty of it, our children will be forced to pay an annual return upon a capitalization based upon the highest prices which 'the traffic will bear.' They will find themselves face to face with powerful interests entrenched behind the doctrine of 'vested rights' and strengthened by every defence which money can buy and the ingenuity of able corporation lawyers can devise. Long before that time they may, and very probably will, have become a consolidated interest, dictating the terms upon which the citizen can conduct his business or earn his livelihood, and not amenable to the wholesome check of local opinion."

Canada cannot afford to have her St. Lawrence River powers pass into the hands of powerful private interests.

St. Lawrence River Situation There has been a marked general tendency to exaggerate the quantities of water-power capable of development. Tentatively, however, let us assume that practically the full low-water flow of the St. Lawrence river is available for power development.

Power development on this river cannot, however, be properly considered apart from the subject of the ice menace. Too great caution cannot be exercised before attempting to harness natural forces of such magnitude as exist in the flow of the St. Lawrence river. Too radical a disturbance of the balance which nature seeks to maintain may cause disaster, and it is well to emphasize these aspects of the problem, for they involve the weighing of basic physical factors of paramount importance.*

If large development should take place, considerable quantities of power would probably, for a time at least, be utilized by electro-chemical industries. With such large power users, the tendency of vendors of electrical energy, is to stipulate that such customers must curtail consumption whenever the supply of generated power is reduced owing to unavoidable causes. By means of such contract arrangements, the requirements of municipalities and of industries requiring smaller amounts of power continuously, may be safeguarded.

Possible Power Sites On the St. Lawrence river below lake Ontario, the first site where a development involving the whole flow of the river could be made, is in the vicinity of Morrisburg. With a dam near the foot of Ogdens island, a head of

*In the special report—*Long Sault Rapids, St. Lawrence River, an Enquiry into the Constitutional and Other Aspects of the Project to Develop Power Therefrom*, by Arthur V. White, Commission of Conservation, Ottawa, 1913—attention is drawn to the great menace which exists in the ice conditions manifested in the St. Lawrence river.

about 11 feet could be obtained, or, taking in a portion of the Galop rapid, possibly a total effective head of about 15 feet. If utilization of the Galop rapid be contemplated, the question of regulating works to control the level of lake Ontario has to be considered. In fact, for certain power developments on the St. Lawrence, the regimen of flow from, and storage in, each and all of the Great lakes must be taken into consideration.

The next possible development is that at the Long Sault rapids where a head of about 35 feet may be created. Some authorities state that the head which may profitably be developed is considerably less than 35 feet; others, again, have thought that it might be increased to nearer 40 feet.

Descending the river we have next, in a stretch of about 14 miles between lakes St. Francis and St. Louis, three series of rapids: the Coteau, the Cedars, the Split Rock and the Cascades.

Coming next to the Lachine rapids below lake St. Louis, we have a head of about 30 feet in $4\frac{1}{2}$ miles. Here 17,000 h.p. is already being developed. The total undeveloped possibilities of the river at this point may be estimated at about 400,000 h.p.

The Cedars Rapids Manufacturing & Power Company utilize at Cedars rapid a head of about 32 feet, developed by means of a diversion canal some two miles long. Ultimately, they will divert 56,000 second-feet. The power house at the foot of the canal is designed for an ultimate development of 180,000 h.p. At present, units aggregating some 100,000 h.p. are installed, and extensions for the complete development are now being made with the immediate addition of two 10,000-h.p. units. This Company is exporting to the United States over 65,000 h.p.

The Soulange plant of the Civic Investment and Industrial Co. is situated a short distance below the Cedars plant. Power is obtained by tapping the Soulange canal through an open headrace half a mile long, the development operating under a head of 50 feet. The installed capacity is some 15,000 h.p., the amount of water available for the plant being subservient to the requirements of navigation through the canal.

The St. Timothée plant of the Canadian Light and Power Co. is on the south side of the St. Lawrence, directly opposite the two last-mentioned developments, and utilizes the descent of both the Coteau and Cedars rapids. The water is led through a portion of the old Beauharnois canal, 7 miles in length. A head of 50 feet is thus obtained. The development is for an ultimate capacity of 75,000 h.p., but the present installation is only for some 30,000 h.p.

At Mille Roches, the St. Lawrence Power Co. has a hydro-electric plant utilizing a portion of the descent in the Long Sault. The development includes a dam which forms an enlargement of the Cornwall canal, with a short, open flume leading to the power plant. The total capacity installed is 2,500 h.p., the equipment operating under a nominal head of 30 feet.

The Beach hydro-electric plant is situated at Iroquois, and utilizes a head of about 12 feet. The present installation is for some 600 h.p. Extensions had at one time been planned to bring it to a total capacity of 2,400 h.p., but were abandoned as they would have seriously interfered with navigation.

There are also two hydro-electric plants at Morrisburg, having a nominal water-wheel capacity of about 1,250 h.p., and yielding about 900 h.p., under a head of 10 feet.

St. Lawrence Water-power To summarize, we may place the estimated low-water power of the international portion of the river

St. Lawrence at about 800,000 h.p., of which Canada is entitled to one-half, or 400,000 h.p. The estimated low-water power on the portion of the river which lies wholly within Canada would be about 1,400,000 h.p.

This, with its share of power along the international boundary, makes an estimated total for Canada of 1,800,000 low-water continuous horse-power. It is detailed in the following table:

WATER-POWER ON THE ST. LAWRENCE RIVER*
(Tentative schedule)

Site	Head available	Estimated low-water 24-hr. h.p.	Average estimated 24-hr. low-water h.p.
Morrisburg-Rapide Plat.....	11-15	170,000-230,000	200,000
Long Sault rapid.....	30-40	500,000-650,000	575,000
Coteau rapid.....	15-17	230,000-260,000	250,000
Cedars rapid†.....	30-32	490,000-525,000	500,000
Split Rock and Cascades rapids.....	14-18	220,000-280,000	250,000
Lachine rapid.....	20-30	300,000-450,000	375,000
Total.....	1,910,000-2,395,000	2,150,000

*In this table, to have the estimates fairly representative of the possible quantities which might be expected under representative low-water flow conditions, some allowances have been made for efficiency and other factors.

† Under development for about one-third of the low-water flow of the river. Consideration would be given to the possibility of combining the Coteau, Cedars, Split Rock and Cascades; also of increasing the Lachine power.

By adjusting their deliveries, vendors of power are frequently able, during certain hours, to sell power which, during other hours, is used by another consumer. For instance, the Hydro-Electric Power Commission of Ontario, by taking into consideration what is technically known as the 'diversity load factor' can, with a power capacity of 250,000 h.p., supply contract requirements of 320,000 h.p.; therefore, assuming such a basis for the St. Lawrence River powers, Canada's 1,800,000 h.p. would take care of a power demand of some 2,400,000 h.p.

**What
65,000 h.p.
Could Do** Few people have any conception of what the 65,000 h.p., now being exported to the United States from the Cedars, could do if widely distributed to customers of light and power. It is worth while to try to realize just what such an amount of power signifies. In 1916, a little less than 50,000 h.p. met the requirements for light and power of the 40,000 customers of the Toronto Hydro-Electric Power Commission. The rates for light and power in Toronto are low, much lower, for example, than in Montreal. Including the requirements of the Toronto Street railway, the Toronto Electric Light Company, and the Toronto Hydro-Electric Power Commission, 120,000 h.p. is now required for light and power in the municipality of Toronto. Therefore, the 65,000 h.p. exported from the Cedars would, if retained in Canada, supply, at cheap rates, all the light and power required by a manufacturing city of 300,000 inhabitants. If distributed through Canadian municipalities, it would supply light and power to some 35 manufacturing cities of 10,000 inhabitants each; or it would practically take care of one-third of the present demands of the Niagara system of the Hydro-Electric Power Commission of Ontario, which supplies over 100 municipalities and 100,000 purchasers of electricity.

A comparison of the benefits resulting from power thus widely distributed, with the localized benefits from the same power utilized in bulk, as in the electro-chemical industries, demonstrates that the former contributes in a much greater degree to the upbuilding of communities and to the growth of the country at large.

**Canada's Markets
Coveted** Is it surprising that the former United States Secretary of War, Hon. Henry L. Stimson, respecting Niagara power, stated that:

"The investigation which has been made by the engineers indicates that Canada, if we do not take it, will use the entire amount that the treaty permits in a very brief time . . . and it would result in giving to Canada, very possibly, a large number of industries which otherwise would be established on this side of the falls."

Is it surprising that, in a report to the Chief of Engineers, U.S.A., Lieut.-Col. J. C. Sanford, stated that:

"If advantage of power generated in Canada cannot be had on the American side, manufacturers will be attracted to Canada by this cheap power, and the industries of this country [the United States] will suffer accordingly. The effect of present restrictions on the importation of power is becoming noticeable . . . Manufacturers at present contracting for additional Niagara power must locate, and are locating, in Canada."

It is noteworthy that the sub-committee on Niagara Falls power, appointed by the Committee on Foreign Affairs, United States House of Representatives, states that it had been urged for its attention:

"That the Canadian companies were rapidly increasing their sales and would very soon take the full amount of water they were entitled to and the United States ought to get what power it was able to *now*. . . . If the advancement in the development of power on the Canadian side increases for another year or so—and it is not apparent to the Committee that it will not—then the Committee concluded that it was proper to take as large an amount as it could get for consumption in the villages, cities, factories and homes along *our* border."

Now, if, after taking the vital subject of Canada's coal supply into full consideration in its international aspect, it is found that the electrical energy generated in Canada can be retained for use here, results will be achieved which are unobtainable if the electricity is exported to the United States.

Canadians should appreciate the fact that the United States has been dealing with them generously in the present distressing coal situation. Portions of the United States are as badly off for coal as portions of Canada. Between the United States and Canada there is an exchange of many natural and manufactured products, and the problems which arise, from time to time, in connection with such interchange can be satisfactorily solved, and the whole situation reduced to a good working basis. Canada, however, must conserve against the day of her own need such resources as are available for barter. These problems call for the best statesmanship which Canada can bring to bear upon them, and, only by a knowledge of all facts relating to the subject, can a wise administrative policy respecting our fuel and power problems be formulated and carried out.

